



# **Advanced Planning and Integration**

## **Human Exploration Systems and Mobility Capability Roadmap Development**

***Dec. 2004***



# Team Charter

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- This roadmap covers a variety of areas that deal with human elements of exploration. Rather than a cohesive theme, this team captures elements that don't appear to fall under any other roadmap domain.
  - Crew Mobility
  - In-Space Assembly
  - In-Space System Deployment
  - Servicing, Maintenance and Repair
  - Human Science Activities



# Relevance

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- Human participation in exploration missions is an essential element of the vision for NASA's future.
- Core capabilities such as In-space assembly, crew mobility, and human science need further development to be able to meet anticipated future needs.
  - Lowered ops costs
  - Larger scale missions
  - Improved ROI for science
  - Higher probability of mission success



# **WBS and Definition for Human Exploration Systems and Mobility**

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## **1.0 Crew Mobility**

- 1.1 Surface Mobility**
- 1.2 In Space Mobility**

## **2.0 In-Space Assembly**

- 2.1 Systems for In-Space Assembly and Inspection Prep and Execution**
- 2.2 Large Scale Assembly Systems**
- 2.3 Intermediate Scale Assembly Systems**
- 2.4 Fine Scale Assembly Systems**
- 2.5 Metrology and Positioning**
- 2.6 Intra-Vehicular Assembly and Construction**
- 2.7 Logistics and Planning for Assembly**
- 2.8 Architectures for Human-Robot Teams**



# **WBS and Definition for Human Exploration Systems and Mobility**

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## **3.0 In-Space System Deployment**

- 3.1 Kinematically-Deployable Systems**
- 3.2 Inflatable Systems**
- 3.3 Deployable Intermediate Precision Systems**
- 3.4 Deployable High Precision Systems**
- 3.5 Structural and Pressurized Interconnections**
- 3.6 Electrical and Data Interconnections**
- 3.7 Thermal and Fluid Interconnections**
- 3.8 Release and Latch-up Systems**
- 3.9 Docking Controls, Mechanisms & Actuators**
- 3.10 Pressurized Module Docking Control and Mechanisms**
- 3.11 Adaptive Self-Assembling System Architectures**



# **WBS and Definition for Human Exploration Systems and Mobility**

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## **4.0 Servicing, Maintenance and Repair**

- 4.1 Extra-Vehicular Inspection**
- 4.2 Non-Destructive Evaluation and Test**
- 4.3 Outgassing, Leak & Contamination Detection**
- 4.4 Electronics Fault Detection, Isolation & Diagnosis**
- 4.5 Software Fault Detection, Isolation and Diagnosis**
- 4.6 Modular Subsystem and Component Replacement Units**
- 4.7 Rescue and Intrusive Repairs**
- 4.8 Propulsion System Refurbishment and Repair**
- 4.9 Refueling and Fluids Resupply Support Systems**
- 4.10 Structural Materials-Level Repair Systems**
- 4.11 Upgradeable and Reconfigurable Systems Concepts**
- 4.12 Standards, Interfaces and Architectures**



# **WBS and Definition for Human Exploration Systems and Mobility**

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## **5.0 Human Science Activities (includes both basic and applied science)**

### **5.1 Field tools**

### **5.2 Tools to repair and monitor resource extraction experiments**

### **5.3 Laboratory equipment (highly automated)**

### **5.4 Rover payloads (instruments, tools as above, sample transport)**

### **5.5 Science via telerobotics**

#### **5.5.1 Teleoperated field geologists (telepresence)**

#### **5.5.2 Payload (instruments, sampling tools, etc.)**

#### **5.5.3 Rover repair**



# Roadmap Events and Schedule

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- Week of Dec 6 Finalize team formation
- Week of Dec. 13 Telecon with full team
- Week of Jan 3 Telecon with full team
- Week of Jan 10 Telecon with full team
- Week of Jan 17 Full team face to face in Houston
- Week of Jan 24
- Week of Jan 31 Telecon with full team
- Week of Feb 7
- Week of Feb 14 Full team face to face in TBD location
- Week of Feb 21
- Week of Feb 28 Telecon with full team
- **Mar. 4<sup>th</sup>** **Draft Roadmap ready**
- Week of Mar 7 Telecon with full team
- Week of Mar 14
- **Mar 15** **NRC Draft presentation ready**
- **Mar 18** **Final Roadmap ready**
- Week of Mar 21 Telecon with full team
- **Mar 25** **Final NRC presentation ready**
- Week of Mar 28 Presentation to NRC, in TBD location

# Backup Slides



# Human Exploration Systems and Mobility Capability Team

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- Chair: Chris Culbert, NASA/Johnson
- Co-Chair: Jeff Taylor, Univ. of Hawaii